Space Weather Technical Forecast

Issued on Saturday, 12 February 2022 at 00:48 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Effects of 06 February CME beginning to slowly wane. Chance of fast wind from a coronal hole over weekend, with a Chance of G1/Minor Storm interval. Active electron fluence is Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours, with only minor C-flares observed. The largest flare was a C2 event observed at 11/1742 UTC from AR2940. There are currently six numbered sunspots on the visible disk, with a strong bias in population towards the western solar horizon and appear to be unipolar, which include AR2940 and AR2939. The largest is AR2941 in the northwest, spanning 17 degrees of solar latitude, and continues to show growth in its intermediate spots, but is otherwise stable. This region is currently classified an Fso/Beta. Meanwhile, AR2946 in the southeast continues to rotate around into the southeast quadrant, which is currently classified as a Dso/Beta. AR2945 in the southwest is stable and classified as an Bxi/Beta. AR2944 is a small and simple Axx/Alpha and will soon be rotating off the visible disc. There are numerous filaments visible in H-Alpha imagery. One of the most noteworthy event of the period occurred at 11/1125 UTC with a filament eruption (seen in the H-Alpha imagery) in the southeast quadrant, with coronal dimming observed in imagery. Simultaneously, another area of coronal dimming was observed in the northwest quadrant. This event produced a CME, which was observed off the east limb in coronagraph imagery at 11/1624UTC. Awaiting imagery for analysis of this CME, although current thoughts are given its trajectory seen in SDO imagery, it is unlikely to be Earth-directed. No Earth-directed Coronal Mass Ejections (CMEs) were in evidence in the period.

Solar Wind / Geomagnetic Activity: Solar winds as measured DSCOVR at L1 began the period at slow-ambient levels, near 380km/s, but increased to become Elevated, with speeds reaching up to 550km/s by the end of the period. The solar wind density was below average at the start of the period, but increased to above average, with a peak value of 40 ppcc at 11/1603 UTC, before gradually declining back towards the average. The Phi angle was predominately negative (towards the sun). The IMF (Bt) was predominately at moderate levels, at around 12nT, at the start of the period, which increased to strong levels, with a peak of 21nT at 11/1736 UTC, before declining to weak levels by end of the period. The all important north-south component (Bz) was mostly positive (northward), with a period of negative (southward) orientation between 11/1747UTC and 11/2145UTC, with a maximum southward component of -16nT at 11/1755UTC. The net result of the above solar wind measures are probably indicative of the tail end of the CME, which left the Sun on 06 February, with onset at L1 from 09/2013UTC. Geomagnetic activity as a result has been mostly Active to Unsettled (Kp3-4) during the period.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at Background levels.

The high energy electron flux (greater than 2MeV) was initially above the High threshold, peaking at 6612pfu at 11/1705UTC, before geomagnetic activity resulted in near background to

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moderate levels for the remainder of the period.

The corresponding 24-hour integrated electron fluence values were above the Active (1e8 integrated pfu) threshold at first, but with a declining trend, before increasing close to the Active threshold again, end the day at 9.32e7 integrated pfu at 12/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain Low through the next four days. Sunspot regions are expected to be in a state of flux in the period, with numerous departures and arrivals, and confidence is therefore low.

Solar Wind / Geomagnetic Activity:
The only CME in the current forecast remains the 06 February CME - ongoing since 09/2010UTC. This is expected to begin waning going into day 1 (Saturday 12 Feb). However, this is likely to be short-lived as the high speed stream from coronal hole 53 is expected to arrive, probably later on day 1 (12 Feb) and lasting into day 2 and day 3 (13 and 14 Feb), with speeds perhaps reaching 600km/s, before slowly declining into day 4 (15 Feb).
Geomagnetic activity is expected to start Active due to residual 06 February CME effects - especially given the current elevated wind speeds, density and IMF, with a Slight Chance of G1/Minor Storm early on day 1 (Saturday 12 February). Mainly Quiet to Unsettled conditions should follow for a time, perhaps becoming Active again later Saturday and into Sunday 13 February, with isolated G1/Minor Storm intervals on onset. Probably staying Active to Unsettled on day 3 (14 Feb), before conditions become Quiet to Unsettled by day 4 (15 Feb) as HSS from CH53 influence begins to wane.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is forecast to be at Background levels, but with a daily Slight Chance of S1 given any significant flares from the regions in the western hemisphere.
The high energy electron forecast is of particularly high uncertainty, but overall a twin peak in risk of Active fluence should bookend the coming four days - initially from the recent waning Active environment and into the new week following a high speed stream from CH53.

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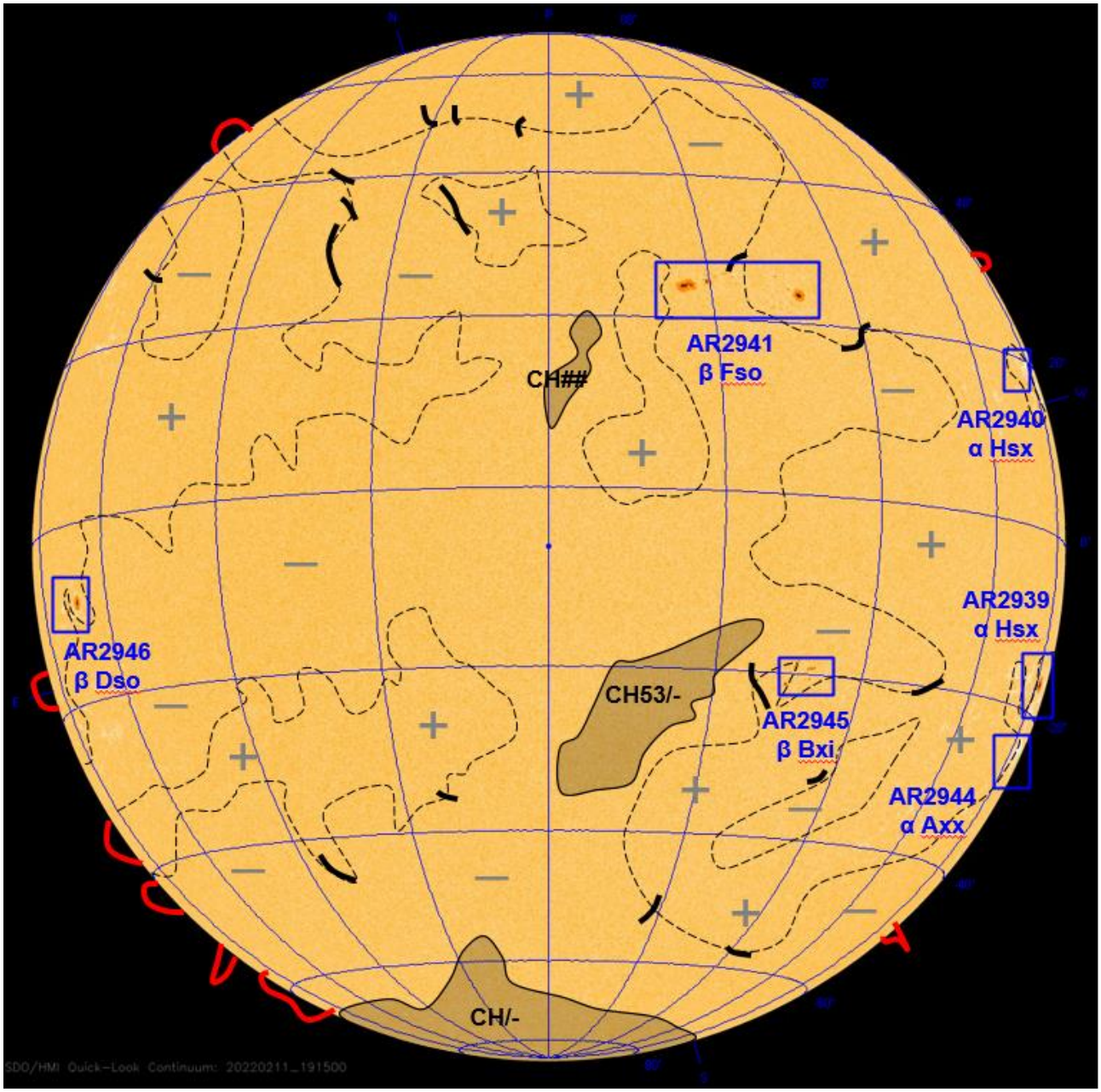
Figure 1. Solar Analysis Valid 11/1915UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Effects from the 06 February CME - ongoing since 09/2010UTC showed a resurgence in the past 24 hours. The cause of this is open to debate, however MOSWOC modelling treated the initial eruption as three separate lobes, with one largely on the ecliptic and two directed below. It may be that this latest discontinuity is an arrival of one of these more narrowly glancing features, although the Bz component was largely unaffected during the change (i.e. was still a relatively smooth sweep through Bz, Bx and By components). Whatever the cause, the effects of this CME should begin wane early on day 1 (12 Feb).

The high speed stream from coronal hole 53 is then expected arrive, perhaps later on day 1 (Saturday 12 February), and lasting on into day 2 (Sunday 13 February), with speeds perhaps eventually reaching 600km/s. This appears to be at odds with current STEREO A MAG and PLASTIC measurements, which suggest a high speed stream-like feature is imminent, perhaps around the turn of the coming UTC day. This may be related to a faint high-latitude feature on the disc, as CH53 appears a little too far eastward at present for this to be the cause.

Geomagnetic activity is expected to start Active due to residual 06 February CME effects - especially given the current elevated wind speeds, density and IMF, with a Slight Chance of G1/Minor Storm early on day 1 (Saturday 12 February). Mainly Quiet to Unsettled conditions should follow for a time, perhaps becoming Active again later Saturday and into Sunday 13 February, with isolated G1/Minor Storm intervals on onset. Probably staying Active to Unsettled on day 3 (14 Feb), before conditions become Quiet to Unsettled by day 4 (15 Feb) as HSS from CH53 influence begins to wane.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	40	30	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil – Note the aforementioned filament eruption and coronal dimming event, which may produce a CME – awaiting coronagraph imagery for analysis.

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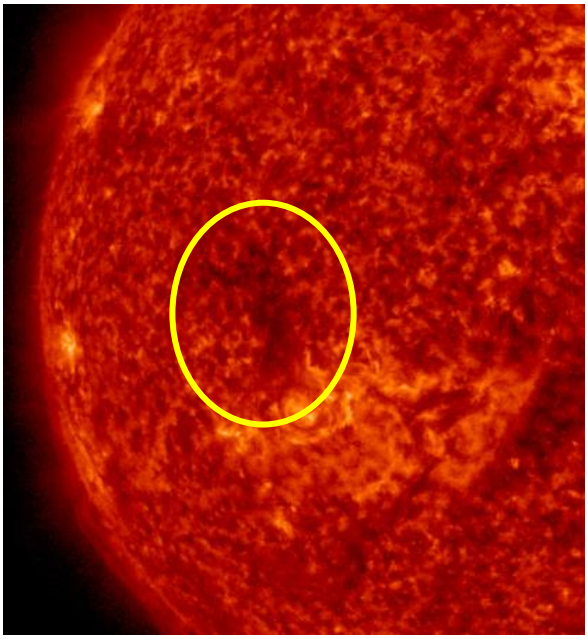
Figure 2 – SDO/AIA 304 imagery shows filament eruption, which produced a CME, although awaiting coronagraph imagery from LASCO and STEREO for analysis.



Radio Blackouts - X-Ray Flares:

The balance of sunspot groups should enter a state of flux over the forecast period. Returning regions Ex-2935 and Ex-2934 should begin to rotate onto the visible disc by the end of the UTC weekend and into the new working week respectively, with both appearing on far-side soundings and EUV imagery, suggesting at least some survival(s) here. This is in contrast to the depopulation expected to occur of the current western limb, with AR2939, AR2940 and AR2944 all expected to leave the disc. This is all happening in the context of a changing disc, with the largest group, AR2941 decaying as an Fso, with this in contrast to currently small newly-developing regions (including AR2945 and 2946) adding further uncertainty to the mix.
The X-ray forecast on balance is unchanged for now, however confidence in the continuation of the current state of affairs is now very low.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	2	2	2	2

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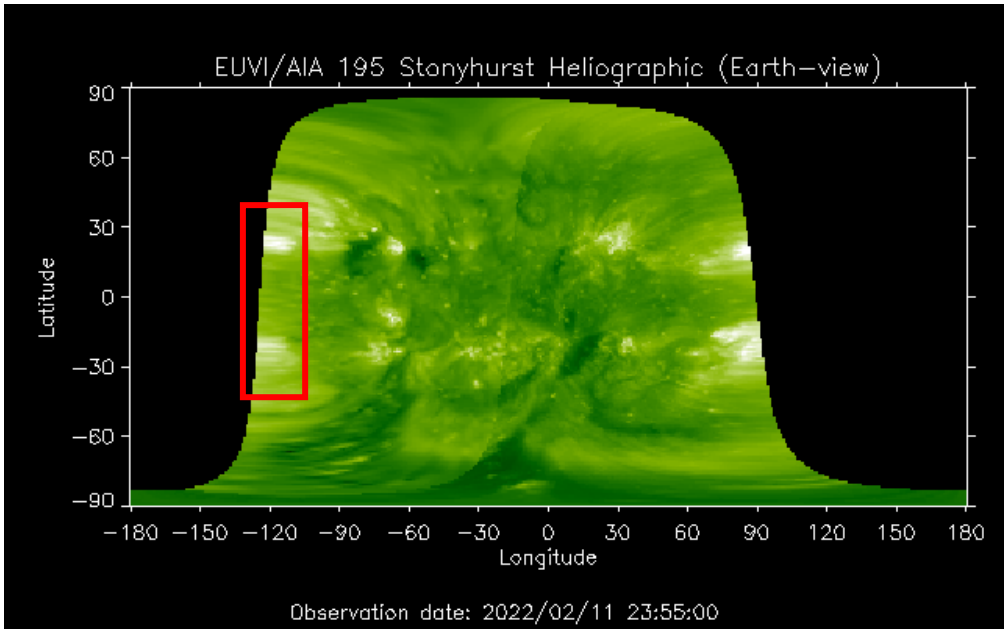
Figure 3: EUVI/AIA 195 heliographic (below) – shows bright flux regions (red square) on the far side, due to rotate onto disc next week.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at Background levels.
Solar radiation storms are unlikely in the period, however, the crowded western limb gives rise to a Slight Chance of S1 should any of these regions flare, with the poor viewing angle now hampering analysis of the many regions here. This risk should begin to wane into the new working week UTC as they more comfortably distance themselves from the western limb on the far side.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	2	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The electron forecast now carries particularly high uncertainty, with current populations very marginal for exceedence of the 24-hour Active fluence threshold in the context of a passing transient and a recent Active period. A degree of recovery is probable in the next 48 hours or so as geomagnetic activity settles down post-CME, with counts then probably again dented for a time by the arrival of CH53 over the UTC weekend.
With a solar wind speed potentially approaching 600km/s from CH53, eventual exceedence late in the period appears Likely, leading to twin peaks in risk of Active bookending the coming four days.

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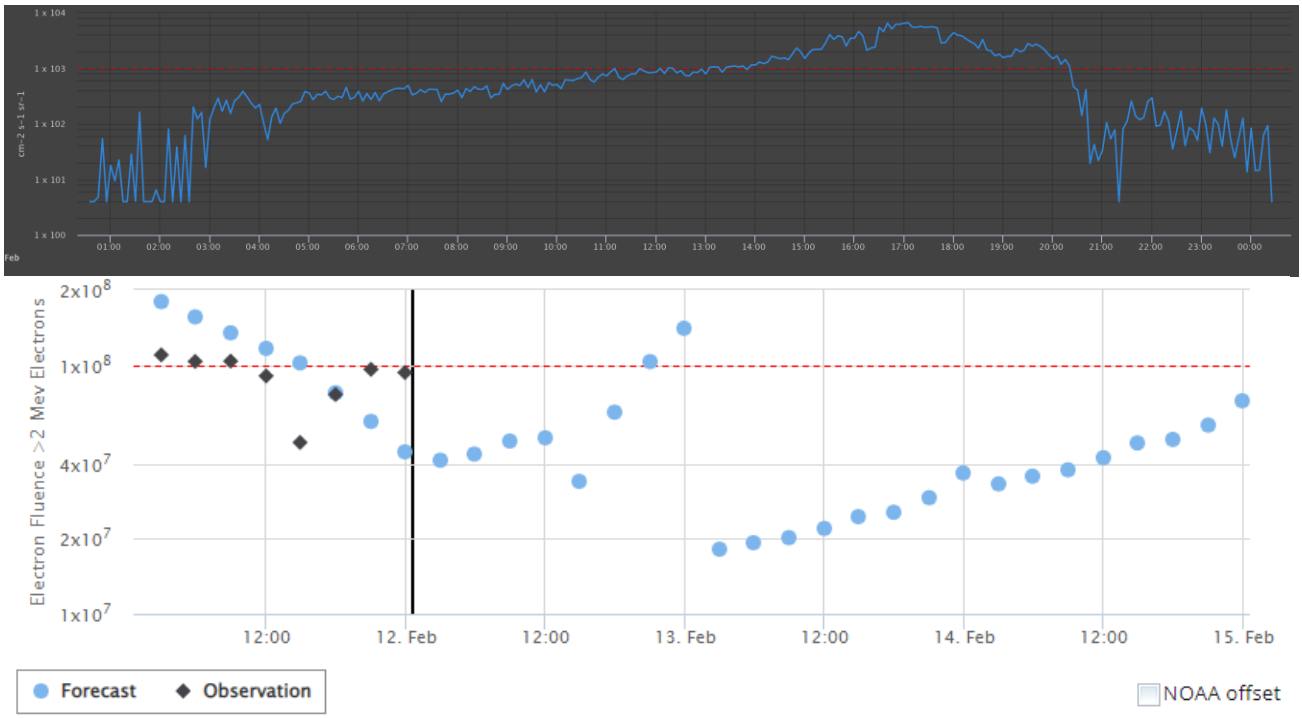
GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	60	40	60	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: GOES-16 electron flux (top) and MOSWOC REFM observed and forecast electron fluence.



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